(12) UK Patent Application (19) GB (11) 2 315 300 (13) A

(43) Date of A Publication 28.01.1998

(21) Application No 9615019.8

(22) Date of Filing 17.07.1996

(51) INT CL^6
F25B 31/02 , F16C 3/20

(52) UK CL (Edition P)
F1M M18
U1S S1966 S2004

(56) Documents Cited
GB 1573649 A GB 1270036 A GB 1162946 A
US 4386859 A US 4263540 A US 4020645 A

(58) Field of Search
UK CL (Edition O) F1M M18
INT CL^6 F16C 3/20 , F25B 31/02
Online: WPI

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(54) Vibration suppression in a motor-driven compressor

(57) A hermetically sealed, motor-driven reciprocating compressor comprises a casing (11), an electric motor (13) in the upper part of the casing and a compressor unit in the lower part of the casing. The motor comprises a stator (15), a rotor (16) and a vertical shaft connected at its upper end to the rotor. The compressor unit comprises a cylinder (20), a piston (19) sliding in the cylinder and a connecting rod (18) connecting the piston to the shaft adjacent to a lower end thereof. In order to counterbalance the vibration transmitted to the shaft by the piston, the former is provided at its lower end with a counterweight (21).

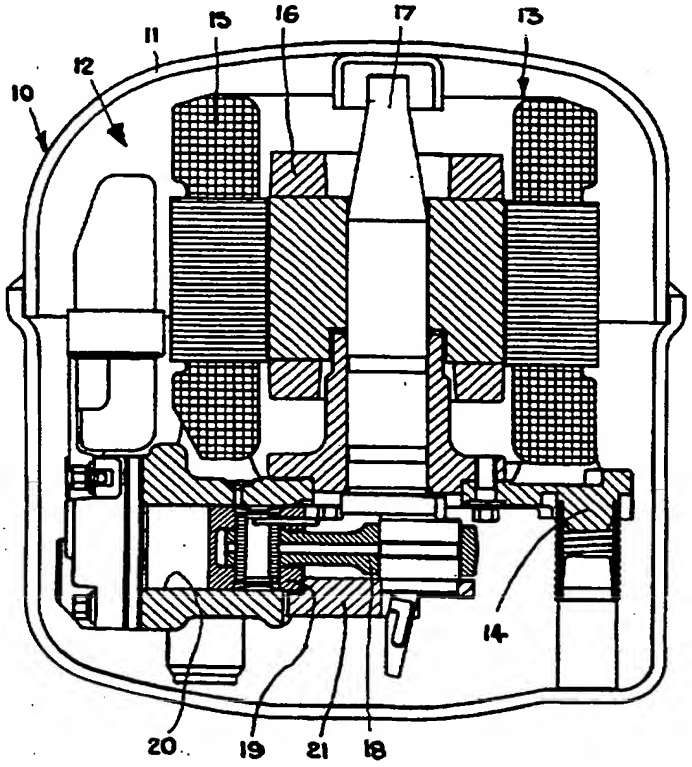

FIG.1

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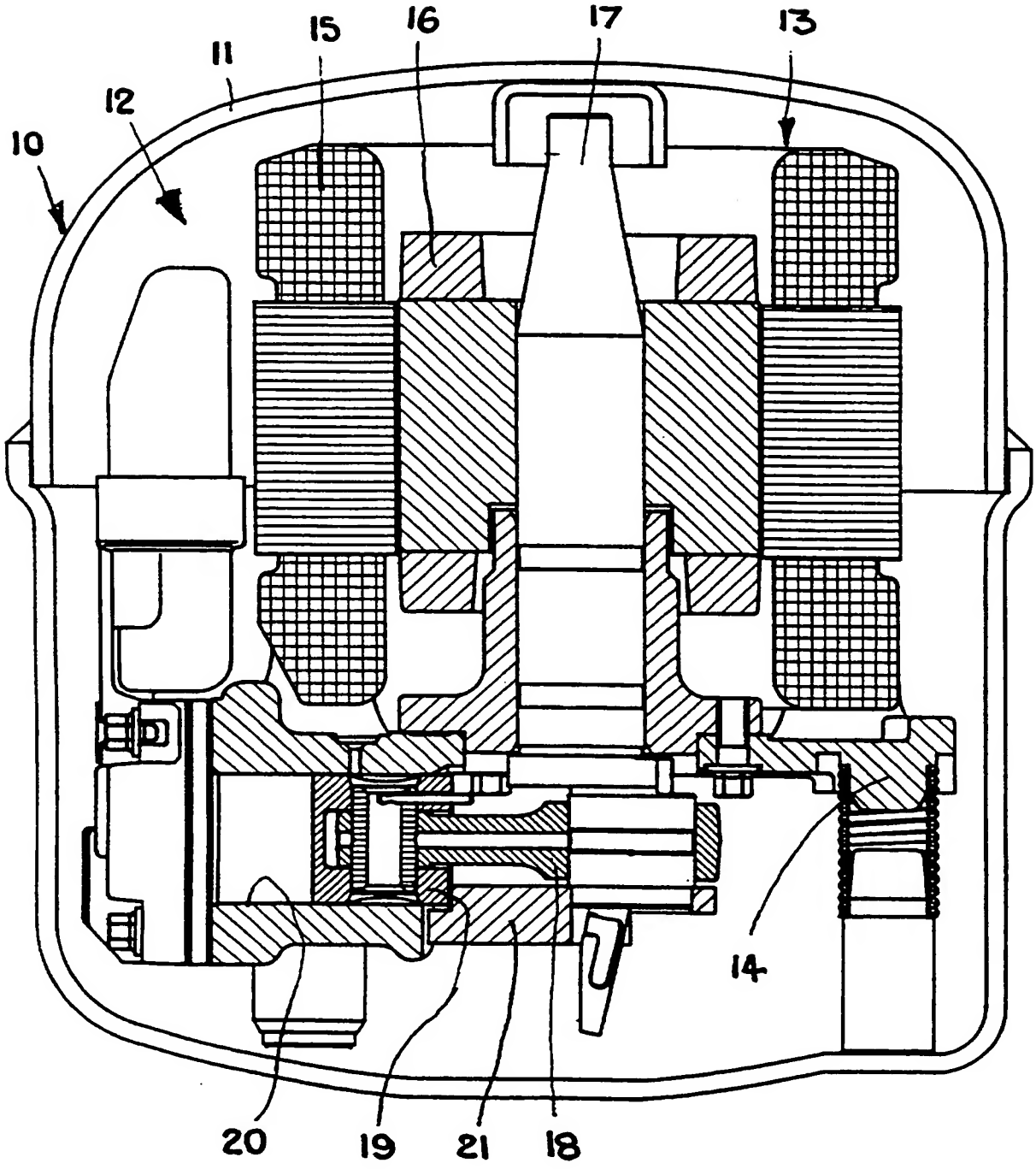

FIG.1

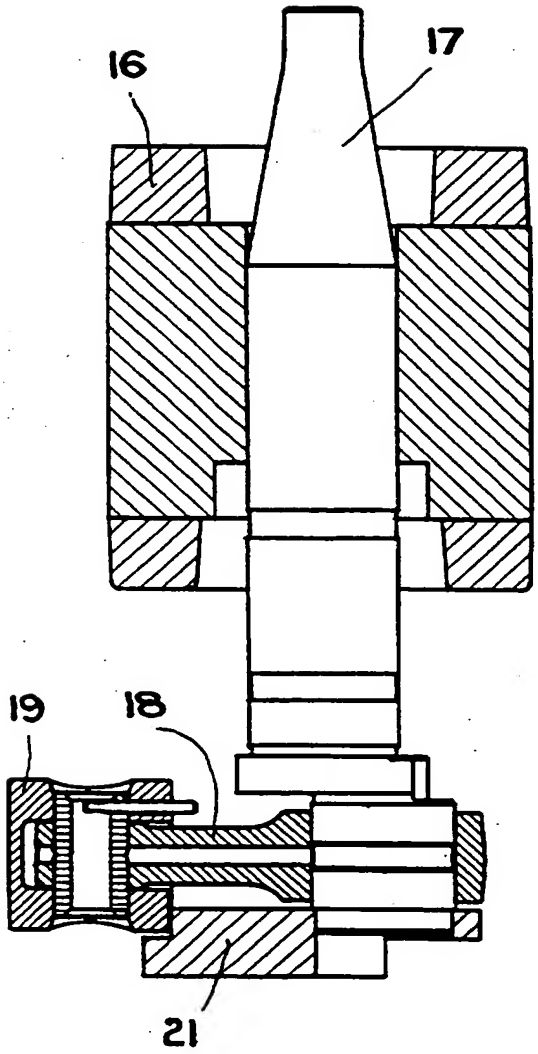

FIG.2

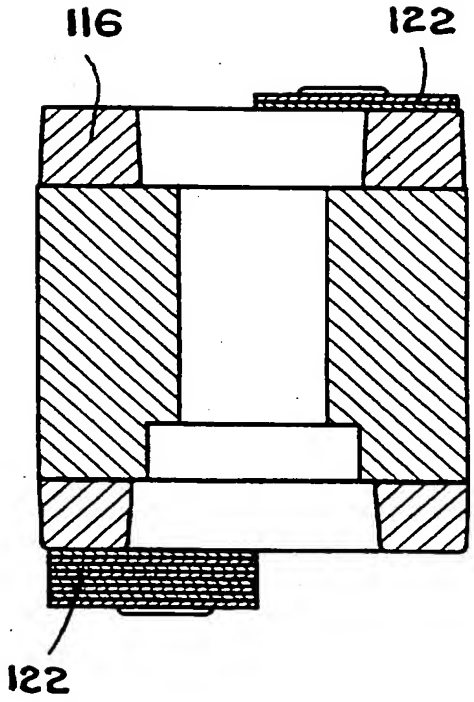

FIG.3

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VIBRATION SUPPRESSION IN A MOTOR-DRIVEN COMPRESSOR

The present invention relates to a hermetically sealed motor-driven reciprocating compressor.

In known motor-driven compressors with an electric motor located in the upper part of a casing and connected to a compressor unit located in the lower part, the rotor of the motor is fixed to the upper end of a vertical shaft, to the lower end of which is attached a device with the function of supplying with lubricating oil, lying in the lower casing part, the compressor parts needing to be lubricated. Pivoted to the shaft adjacent to such device is a connecting rod which actuates a piston to execute linear displacement within a cylinder for the purpose of inducting, compressing and pumping refrigerant gas into a refrigerating circuit.

Along the connecting rod centre line a force is generated that must be counterbalanced in order to obtain optimal efficiency of the compressor. Such balancing is achieved by placing, at the rotor ends, a number of laminations, which have the function of counteracting the moment generated on the shaft, close to the connecting rod centre line. This moment varies in relation to the length of connecting rod.

Such a compressor configuration still causes vibrations and consequently noise. Since the compressors are mounted in domestic refrigerators and thus installed in houses, the noise produced by the compressors is audible, especially at night when environment noises lessen.

Apart from energy saving by improving the efficiency of the compressor and reduction of environment pollution by using non-

polluting refrigerant gases, there is now a sensitivity to reduction in noise output and consequently refrigeration compressor manufacturers are compelled to reduce the noise produced by hermetic motor compressors.

Some improvements have been achieved by designing new shapes for the casing and by placing mufflers on suction and discharge pipes. However, very little has been done in the direction of reducing the vibrations caused by the moving parts.

A particular source of vibration inside a motor-driven compressor is represented by the poor counterbalancing of the force exerted by the piston on the shaft through the connecting rod.

The object of the present invention is to overcome the above described disadvantages, in particular reduction of the vibration on the shaft without affecting costs.

According to the present invention there is provided a shaft for a hermetically sealed, motor-driven reciprocating compressor, wherein the compressor comprises an electric motor, located in an upper shell of a casing and comprising a stator and a rotor, and fastened to a compressor block, located in a lower shell of the casing, with a cylinder machined into the block, wherein a piston slides in the cylinder and is connected to a connecting rod end, characterised in that the upper end of the shaft is fastened to the rotor and that close to its lower end it is connected to the other end of the connecting rod in order to transform the rotary motion of the rotor into rectilinear motion of the piston, means being provided on the shaft close to the connection of the connecting rod with the shaft for counterbalancing the forces transmitted by the piston.

Preferably, said means comprises a counterweight which is fixed to

the lower end of the shaft below the connection of the connecting rod with the shaft.

An embodiment of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a vertical cross section of a compressor embodying the present invention;

Fig. 2 is a sectional view, to an enlarged scale, of a rotor shaft and rod assembly of the compressor of Fig. 1; and

Fig. 3 is a sectional view of a known form of rotor.

Referring now to the drawings, there is shown in Fig. 1 a hermetically sealed, motor-driven reciprocating compressor 11 comprising a casing 11 containing a compressor assembly 12, which is composed of an electric motor 13 mounted on the upper side of a compressor block 14. The motor 13 comprises a stator 15 and a rotor 16. The rotor 16 is rigidly connected with a vertical shaft 17, which actuates a connecting rod 18 for transforming, by a known method such as a crankpin, the rotary motion of the shaft 17 into rectilinear motion of a piston 19 which slides in a cylinder 20 machined into the compressor block 14.

In use, movement of the piston 19 causes refrigerant gas to be sucked into the cylinder 20, compressed and pumped into a refrigerating circuit.

The forces transmitted by piston 19, during its operative phase, by way of the connecting rod 18 to the shaft 17 are counterbalanced by a counterweight 21 placed on the shaft close to the connection of the connecting rod. The counterweight 21, properly dimensioned, counterbalances the forces transmitted by the piston 19 to the shaft

17. As a result, the vibrations of the shaft 17 are very small, which results in a considerable reduction in noise output.

Fig. 3 shows a prior art rotor 116 in which, to counterbalance the force transmitted by the piston to the shaft, a number of laminations 122 is fitted to each end of the rotor. The number of laminations varies in relation to the piston displacement and to the length of the connecting rod. Since the laminations 122 are far from the point of application of the force to the shaft, they are not capable of balancing the shaft properly, which results in strong vibrations and consequently in a high noise level.

In order to place the counterweight 21 on the shaft 17 close to the point of connection of the connecting rod 18, it may be necessary to reduce the friction among the various moving parts and to optimise the quantity of lubricating oil in the bottom of the casing 11.

CLAIMS

1. A hermetically sealed motor-driven reciprocating compressor comprising a casing, an electric motor disposed in an upper part of the casing and comprising a stator, a rotor and a shaft connected at an upper end thereof to the rotor, and a compressor unit disposed in a lower part of the casing and comprising a cylinder, a piston slidably engaged in the cylinder and a connecting rod connected at one end to the piston and at the other end to the shaft adjacent to the lower end thereof to translate rotary motion of the rotor into rectilinear movement of the piston in the cylinder, means being provided on the shaft adjacent to the connection to the connecting rod to counterbalance forces transmitted by the piston to the shaft and rotor.

2. A compressor as claimed in claim 1, said means being a counterweight arranged on the shaft of the lower end thereof and below the connection of the shaft to the connecting rod.

3. A compressor substantially as hereinbefore described with reference to Figs. 1 and 2 of the accompanying drawings.

The Patent Office

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Application No: GB 9615019.8 **Examiner:** John Twin
Claims searched: 1,2 **Date of search:** 23 September 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F1M (M18)

Int Cl (Ed.6): F16C 3/20; F25B 31/02

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1573649	(Danfoss) - note weight 12, fig.1	1,2
X	GB 1270036	(Danfoss) - see eg fig.2; page2, lines 90-98	1,2
X	GB 1162946	(Danfoss) - see eg page 2, line 130 to page 3, line 7	1
X	US 4386859	(Aspera) - see weight 32 in fig.1	1,2
X	US 4263540	(GEC) - see eg fig.1	1,2
X	US 4020645	(Pittatone) - see eg fig.1	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.